GPS FIELD APPROVAL PROCESS

SEATTLE FLIGHT STANDARDS DISTRICT OFFICE

Latest Revision: October 31, 2002

List of effective pages:

Page number	Page title	Page date
1	List of effective pages and change record	10-31-02
2	GPS Field Approval Process	10-31-02
3	Form A, Sample of Block 8 entry for VFR installation	10-31-02
4	Form A (continue)	10-31-02
5	Form B, Ground Test Checklist	10-31-02
6	Form C, VFR Functional Flight Evaluation Checklist	01-20-99
7	Form D, Sample of Block 8 entry for IFR Upgrade	10-31-02
8	Form E, IFR Functional Flight Evaluation Checklist	01-20-99

Revisions:

01-14-99	Correct spelling, format and clarity of instructions.
01-20-99	Enter the word “transmitting” in item 1 of the checklist. Also improve the wording on the checklist.
05-02-01	Added sequence of events and changed wording on form A.
01-31-02	Added additional items to block 8 of forms A, B & D. Also corrected punctuation within form B.

GPS FIELD APPROVAL PROCESS

SEATTLE FLIGHT STANDARDS DISTRICT OFFICE

Latest Revision: October 31, 2002

This purpose of this document is to standardize and simplify the field approval process of GPS installations. It follows Advisory Circular 20-138, Airworthiness Approval of Global Positioning System (GPS) Navigation Equipment for Use as a VFR and IFR Supplemental Navigation System, dated May 25, 1994. It is an acceptable means, but not the only means, of obtaining a field approval. Following this guidance will make it easier for airworthiness inspectors to evaluate GPS field approval requests, which should expedite the field approval process.

If you are doing a VFR installation only, use Forms A, B, and C.

IFR installations require a more rigorous functional flight evaluation, GPS equipment that meets TSO C-129, Class A standards, and an approved flight manual supplement.

If you are doing an IFR installation, you will do two field approvals:

1. A VFR installation, Forms A, B, and C.
2. An IFR upgrade, Form D and E.

Note: Only one field approval will be required to upgrade to IFR if the VFR GPS was installed previously (with a field approval).

The sequence of events for the successful completion of the installation is as follows:

1. The person or agency submits the form 337 in duplicate, and all of the applicable data to the Seattle FSDO for data approval before any work begins on the aircraft.
2. The Seattle FSDO inspector will review the submitted data and 337 forms and if acceptable, sign block 3.
3. The inspector will send the signed 337 forms and data package back to the applicant so that work may commence on the aircraft.
4. When the work is accomplished, conforms to the approved data, and form B (ground test checklist) is complete, the person or agency signs block 6 and 7 of the 337s.
5. A log book entry is made for the installation of the GPS and includes a statement with the following or similar wording:
   "The installed GPS system must undergo an operational check in accordance with FAR 91.407(b) by at least a private pilot and results entered into the aircraft records"
6. Form C may be used as an aircraft record if it is kept with the 337. Otherwise, a log entry must be made by the person performing the operational check stating that the check was satifactory or list the discrepancies.
7. One 337 is given to the owner and one is sent back to the FSDO with Form C for filing.
8. If the system is to be upgraded for IFR, then the procedures to complete forms D and E must be followed.

If you have any questions, please call the Seattle FSDO at 1-800-354-1940 and ask for an Avionics Inspector.

SAMPLE FORM 337, BLOCK 8 ENTRY, FOR THE INSTALLATION OF A VFR GPS SYSTEM.

NOTE: You must submit all data to the FSDO for approval. Therefore, all required drawings must show how wiring, hardware, materials, and practices used in the installation conform to Federal Aviation Regulations, the aircraft and equipment manufacturer's instructions, and aviation standards appropriate to the aircraft as certificated. Replace bracketed [____] items with the indicated information.

Incomplete data packages will not be approved and will be returned to the applicant.

8. **Description of Work Accomplished**
(If more space is required, attach additional sheets. Identify with aircraft nationality and registration mark and date work completed.

The certification rule used as a basis for this field approval is [**State the certification basis of the aircraft, Part 23, 25, 27, or 29**]

The aircraft records have been reviewed and the aircraft has been inspected for previous alterations or repairs that have not been recorded. Previously completed alterations or repairs, if applicable, have been evaluated for compatibility with this installation.

Installed [**make & model**] GPS according to the criteria for "Follow-On VFR GPS" installations as specified in paragraph 7c(2) of AC 20-138, Dated May 25, 1994. This "Follow-On" installation is referenced to the initial installation approved under STC [provide **number and copy**], and as follows:

1. Installed [**make & model**] GPS system according to [**make & model**] installation instruction number [_____] and as shown on electrical drawing number, (include date and /or revision number)_____.

2. Provide power to the GPS system from the [**buss name**] [**voltage**] volt DC Buss through a [**size**] circuit breaker mounted [**where**] that is accessible to the pilot in flight. See electrical drawing or sketch number_____. Electrical load analysis verifies that total electrical load requirements are within capabilities of aircraft electrical generating system.

3. Installed the [**model**] receiver in the airframe manufacturer provided instrument panel or radio rack at FS [____]. If a structural drawing is made include the number_____. Otherwise reference the installation manual.

4. Installed the [**model**] GPS Antenna on the top of the fuselage at FS [____] using the existing antenna mounting provisions. If a structural drawing is made include the number_____. Otherwise reference the installation manual.

   [YOU MUST DECLARE ONE OR MORE OF THE FOLLOWING, AS APPROPRIATE]

   [IF APPLICABLE]
   The GPS is not connected to an external CDI. The GPS is not connected to the Autopilot.

   [IF APPLICABLE]
   The GPS supplies information to the [**make and model**] [**course deviation indicator (CDI)**] used only by the GPS. Install this indicator in existing mounting provisions in the pilots instrument panel at FS [____].

   [IF APPLICABLE]
   The GPS supplies information to the existing [**make and model**] [**horizontal situation indicator (HSI) or course deviation indicator (CDI)**] which also displays information from [**specify the other systems normally used for aircraft navigation**]. Provide a [**make & model**] Navigation Source annunciator [**on or adjacent to**] the [**make & model**] display. Provide power to the [**HSI/CDI**] switching system through a [**make & model**] circuit breaker mounted [**where**] which is accessible to the pilot in flight. Wire according to the attached drawing number [_____]. Mount the source annunciator as shown on the attached drawing number [_____].

   [IF APPLICABLE]
   Couple the GPS to the "Radio NAV" function of the [**make & model**] autopilot as shown on the attached drawing number [___].

   [IF APPLICABLE]
   Address method used to verify proper wiring connections between altitude encoder and GPS.

5. The structural mounting of the GPS equipment is sufficient to ensure the restraint of the equipment when subjected to emergency landing loads appropriate to the aircraft category. Verify this according to FAA AC .13-2A Chapter 1, paragraph 1, 2, & 3.

SAMPLE FORM 337, BLOCK 8 ENTRY, FOR THE INSTALLATION OF A VFR GPS SYSTEM.

NOTE: You must submit all data to the FSDO for approval. Therefore, all required drawings must show how wiring, hardware, materials, and practices used in the installation conform to Federal Aviation Regulations, the aircraft and equipment manufacturer's instructions, and aviation standards appropriate to the aircraft as certificated. Replace bracketed [____] items with the indicated information.

Incomplete data packages will not be approved and will be returned to the applicant.

6. The electrical system installation meets the requirements of AC 43.13.2A, Chapter 2, Paragraph 27.

7. INSTALLATION DATA EVALUATION Checked [**make & model**] GPS installation for conformity to the criteria specified in paragraph 7c(1)(ii) of AC 20-138, dated May 25, 1994, as shown by the attached Ground Test checklist, dated _____.

8. FUNCTIONAL FLIGHT EVALUATION An entry into the aircraft records is made stating "the installed GPS system must undergo an operational check in accordance with FAR 91.407(b) by at least a private pilot and the results entered into the aircraft records"

9. Install a placard(s) with the GPS controls and displays that state(s) "GPS LIMITED TO VFR USE ONLY".
[**Indicate the location for each placard**].

10. Amend the aircraft equipment list. Calculate and enter the new weight and balance in the aircraft weight and balance record.

11. Instructions For Continued Airworthiness:

a. See attached electrical system schematic for troubleshooting information for this installation. Additional troubleshooting information may be found in [**List the manufacturer's installation and maintenance manual**].

b. This installation shall be inspected [**either annually, each 100 hours of operation, or in accordance with the inspection program of the aircraft at intervals of _____, as applicable]**, in accordance with the guidelines found in AC 43.13.1A, Chapter 12, Section 1.

c. The components of this system may be removed and reinstalled in accordance with [**Reference the manufacturer's installation manual, or any other appropriate information for this action**].

d. For commuter category aircraft, an electrical load analysis will be required to be included in these instructions.

e. If any overhaul periods, or FAA approved airworthiness limitations are applicable to the installed equipment, these requirements should be listed in these instructions.

To revise these Instructions for Continued Airworthiness, a letter should be submitted to the local FSDO with a copy of the revised Form 337 and revised Instructions for Continued Airworthiness. The FAA inspector accepts the changes by signing block 3, and including the following statement: "The attached revised/new instructions of continued airworthiness dated_____ for the above aircraft major alteration have been accepted by the FAA, superceding the Instructions for Continued Airworthiness dated _____." A maintenance record entry will be made, identifying the revision, its location, and date of the Form 337.

GROUND TEST CHECKLIST

Aircraft Make and Model:_____ **Registration Number:_____**

GROUND TEST CHECKLIST VFR APPROVAL	TECHNICIAN INITIALS
1. **Electromagnetic Compatibility**. The GPS equipment installation does not interfere with the normal operation of other equipment installed in the aircraft. Note: Verify adequate isolation from interference of VHF transceivers by tuning to the following frequencies and transmitting for a period of 20 seconds while observing the signal status of each satellite being received (degradation of navigation signal is unacceptable). VHF frequencies to test: 121.150 MHZ, 121.175 MHZ, 121.200 MHZ, 131.250 MHZ, 131.275 MHZ, 131.300 MHZ	
2. **Environmental Conditions**. The aircraft environment in which the GPS equipment is installed is appropriate to the environmental categories (or criteria) to which the equipment has been tested.	
3. **Equipment Mounting**. The structural mounting of the GPS equipment, including antenna, is sufficient to meet all structural mounting, dynamic, and emergency landing loads appropriate to the aircraft category.	
4. **Navigation Source Annunciator**. A navigation source annunciator is provided on or adjacent to each affected display if the GPS installation supplies any information to displays such as a horizontal situation indicator (HSI), course deviation indicator (CDI), distance display, electronic map, etc., which can also display information from other systems normally used for aircraft navigation.	
5. **VFR Limitation Placard**. A placard stating "GPS limited to VFR use only" must be installed in clear view of and readily readable by the pilot.	
6. **Autopilot/Flight Director Coupling**. The GPS navigation system may be coupled to an autopilot and/or flight director provided the GPS system has a deviation or steering output that is compatible with the autopilot/flight director system and no unusual interface is required. Approval of an autopilot/flight director interface will require a flight evaluation to demonstrate satisfactory performance using all cross-track deviation sensitivity selections available to the pilot.	
7. **Accuracy Demonstration**. A ground system accuracy test is conducted to verify the system meets the en route/terminal navigation accuracy criteria contained in paragraph 6a of Advisory Circular 20-138.	
8. **Computer Software**. There are no certification standards for the software contained in systems limited to VFR use only. The FAA recommends that the standards for IFR equipment contained in paragraph 8b(1) of AC 20-138 be followed if the system is intended to be upgraded to IFR use in the future.	
9. **Failure Protection.** Any probable failure of the airborne GPS navigation system must not degrade the normal operation of other required equipment or create a flight hazard. Likewise, normal operation of the GPS equipment installation cannot adversely affect the performance of other aircraft equipment. The interfaces with other aircraft equipment must be designed such that normal or abnormal GPS equipment operation does not adversely affect the operation of other equipment. Normal or abnormal operation of other equipment shall not adversely affect the GPS equipment operation.	
10. **System Controls, Displays and Annunciators**.	
• All displays, controls, and annunciators must be easily readable under all normal cockpit conditions and expected ambient light conditions (total darkness to bright reflected sunlight).	
• Night lighting provisions must be consistent with other cockpit lighting.	
• All displays and controls should be arranged to facilitate equipment usage.	
• Controls that are normally adjusted in flight shall be readily accessible and properly labeled as to their function.	
• System controls and displays should be designed to maximize operational suitability and minimize pilot workload.	
• System controls should be arranged to provide adequate protection against inadvertent system turnoff.	
• Reliance on pilot memory for operational procedures shall be minimized.	
11. **Navigation/Integrity Annunciation**. The GPS equipment indicates, independent of any operator action, the following by means of a navigation warning flag on the navigation display:	
(a) The absence of power required for the navigation function.	
(b) Probable equipment malfunctions or failures affecting the navigation function.	
(c) Loss of navigation function. If the equipment provides an integrity monitoring function (such as RAIM), an appropriately located annunciator shall be provided to indicate loss of the RAIM function or a position error exceeding 2.0 nm position integrity performance detected by the RAIM function. **NOTE:** Presentation of a failure/status annunciation (flag or integrity annunciation) does not require removal of navigation information from the navigation display. Consideration should be given to continued display of navigation information concurrent with the failure/status annunciation when conditions warrant.	
12. **Manufacturer's Instructions**. The GPS equipment, including antenna, must be installed in accordance with the instructions and limitations provided by the manufacturer of the equipment.	

I certify that the requirements of items 1 through 12 of this Ground Test Checklist have been met and that the aircraft is ready for a functional flight evaluation.

Signed_____ Date_____

(insert Repair Station name and number or IA name and number)

VFR FUNCTIONAL FLIGHT EVALUATION CHECKLIST

Aircraft Make and Model:_____ **Registration Number:_____**

VFR FUNCTIONAL FLIGHT EVALUATION CHECKLIST AC 20-138 7c(1)(iv)	**Technician or Pilot initials**
(A) Evaluation of installed GPS navigation system to verify that it is functioning properly, safely, and operates in accordance with the manufacturer's specifications.	
(B) Evaluation of steering response while the autopilot and/or flight director is coupled to the GPS equipment during a variety of different track and mode changes. All available display sensitivities should be evaluated.	
(C) Evaluation to verify the GPS installation does not adversely affect other onboard equipment (this test may be partially accomplished as a ground test).	
(D) **NOTE: the requirement for 5 low level overflights of one or more surveyed locations is no longer required for VFR GPS installations**.	Not Applicable
(E) Evaluation of the accessibility of all controls pertaining to the GPS installation.	
(F) Evaluation of the visibility of the controls, displays, and annunciators relating to the GPS installation during day and night lighting conditions. No distracting cockpit glare or reflections may be introduced and all controls must be illuminated for identification and ease of use. Night lighting shall be consistent with other cockpit lighting.	

I certify that I performed a functional flight evaluation to verify the items of this VFR Functional Flight Evaluation Checklist and the results were satisfactory.

_____ _____

Pilot's Signature, Certificate No. Date

CERTIFICATION OF THE FUNCTIONAL FLIGHT EVALUATION

I certify that the data contained or referenced herein accurately reflects the final installation configuration of the ___[**make & model**]___ GPS in this aircraft. This final configuration has been inspected according to the instructions of this procedure and the results have been accurately recorded. All discrepancies have been corrected.

Signed_____ Date_____

___(insert Repair Station name and number or IA name and number)___

SAMPLE FORM 337, BLOCK 8, ENTRY FOR THE IFR UPGRADE INSTALLATION OF A GPS SYSTEM.

Aircraft Make and Model:_____ Registration Number:_____

NOTE: You must submit all data to the FSDO for approval. The GPS system must have been approved for VFR use before this 337 is approved. Therefore, any additional drawings must show how wiring, hardware, materials, and practices used in the IFR installation conform to Federal Aviation Regulations, the aircraft and equipment manufacturer's instructions, and aviation standards appropriate to the aircraft as certificated. Replace bracketed [____] items with the indicated information.

Incomplete data packages will not be approved and will be returned to the applicant.

8. **Description of Work Accomplished**
(If more space is required, attach additional sheets. Identifiy with aircraft nationality and registration mark and date work completed.

The certification rule used as a basis for this field approval is [State the certification basis of the aircraft, Part 23, 25, 27, or 29].

The aircraft records have been reviewed and the aircraft has been inspected for previous alterations or repairs that have not been recorded. Previously completed alterations or repairs, if applicable, have been evaluated for compatibility with this alteration.

1. The [**make & model**] GPS system was previously approved for VFR use on FAA form 337 for this aircraft on [**date of 337**].
2. This installation was accomplished in accordance with paragraph 8c(2) of AC 20-138 dated May 25, 1994.
3. This GPS system is not the sole means of navigation for this aircraft.
4. This GPS system meets the requirements of TSO C-129 as stated from the manufacturer.
5. FUNCTIONAL FLIGHT EVALUATION Perform a functional flight evaluation covering the items listed in paragraph 8c(2)(iv)(excluding paragraph (H)) of AC 20-138, Dated May 25, 1994. See attached IFR Functional Flight Evaluation Checklist dated _____. (Or a similar form generated by the installer).
6. This installation is approved for IFR operations under [**state class of GPS equipment**] and must be conducted in accordance with the guidelines and limitations per [**make &model**] Flight Manual Supplement dated [**date of Flight Manual Supplement**] including the preflight test to ensure continued airworthiness.
7. If any new equipment was added to the VFR installation, amend the aircraft equipment list. Calculate and enter the new weight in the aircraft weight and balance record.
8. Instructions for Continued Airworthiness:

   a. If no additional equipment has been added to gain approval from the original VFR approval, a reference should be made to the VFR form 337 for the Instructions for Continued Airworthiness.

   b. If additional equipment has been added to gain IFR approval, Instructions for Continued Airworthiness for these additional items should be added to the form 337 covering IFR approval.

IFR FUNCTIONAL FLIGHT EVALUATION CHECKLIST

Aircraft Make and Model:_____ **Registration Number:**_____

IFR FUNCTIONAL FLIGHT EVALUATION CHECKLIST AC 20-138, 8.c.(2)(iv)	**Technician or Pilot initials**
(A) Overall operation of the installed GPS equipment, including interface with other equipment in the aircraft.	
(B) The effect(s) of GPS equipment failure (open circuit breaker), including autopilot/flight director response, if applicable.	
(C) If interfaced with an autopilot and/or flight director, steering response while the autopilot and/or flight director is coupled to the GPS equipment.	
(D) Displayed GPS navigation parameters on all interfaced cockpit instruments.	
(E) The effect(s), if any, of switching and transfer functions, including electrical bus switching, pertaining to the GPS installation.	
(F) Evaluation to determine satisfactory electromagnetic compatibility (EMC) between the GPS installation and other equipment as specified in paragraph 8c(1)(iv)(F) of this AC: (may be partially done as ground test) **Note 1:** Particular attention should be given to "L" band equip such as TCAS or SATCOM, HF radios and other transmitting equipment (ACARS, AFIS, Flightfone,etc.) **Note 2:** Installation instructions for each GPS receiver installation shall include verification of adequate isolation from interference of VHF comm transceivers. These tests shall be conducted on the completed GPS installation by tuning each VHF transmitter to the frequencies listed below and transmitting for 20 seconds while observing the signal status of each satellite being received. Degradation of individually received satellite signals below a point where navigation is no longer possible is not acceptable and will require additional isolation measures (low pass or notch filters installed at the output of the VHF transmitter, additional spacing between the VHF and GPS antenna, replacement of the VHF transmitter with a unit having no excessive harmonic emissions, etc.) be included in the aircraft installation. Reevaluation of installed VHF transceiver performance is not necessary if the filter insertion loss is 2 dB or less. The following frequencies shall be evaluated: 121.150 MHZ,121.175MHZ, 121.200MHZ, 131.250MHZ,131.275MHZ,131.300MHZ	
(G) Accessibility and visibility (day and night conditions) of all controls pertaining to the GPS installation.	
(H) **Note**: **The requirement to validate the GPS accuracy in each operating mode as specified in 8c(1)(iv)(J)is no longer required for IFR GPS installations**.	Not Applicable
(I) Verify continuity of navigation data during 360 degree left and right turns at 30 degrees of bank.	
(J) Monitor displayed cross-track error during enroute, and, if applicable, approach transition and approach operations to verify FTE is less than 1.0 nmi (enroute and approach transition) and .25nmi (approach), both with and without use of the autopilot and flight director (if installed).	
(K) For equipment approved for approach, conduct at least three published instrument approaches (retrieved from the data base) to verify proper operation of the equipment in the approach environment.	

I certify that I performed a functional flight evaluation to verify the items of this IFR Functional Flight Evaluation Checklist and the results were satisfactory.

_____ _____

Pilot's Signature and Certificate No. Date

CERTIFICATION OF THE FUNCTIONAL FLIGHT EVALUATION

I certify that the data contained or referenced herein accurately reflects the final installation configuration of the ___[**Make & Model**]___ GPS in this aircraft. This final configuration has been inspected according to the instructions of this procedure and the results have been accurately recorded. All discrepancies have been corrected and reported to the FSDO.

Signed_____ Date_____

___(insert Repair Station name and number or IA name and number)__